International Journal of Trends in Mathematics Education Research
Vol. 2, No. 4, August 2019, pp. 184-187
Available online at http://ijtmer.com

E-ISSN : 2621-8488

RESEARCH ARTICLE

The Students' Mathematical Representation in Geometry Problem Solving Based Sex Differences

Adnan. S[1]*, Dwi Juniati[1], Raden Sulaiman[1]

[1] Department of Mathematics Education, Surabaya State University, Surabaya, Indonesia
*Corresponding Author: adnan.17070785032@mhs.unesa.ac.id

How to Cite: Adnan, Juniati, D & Sulaiman, R. (2019). The Students' Mathematical Representation in Geometry Problem Solving Based Sex Differences. *International Journal of Trends in Mathematics Education Research, 2*(4), 184-187. doi: 10.33122/ijtmer.v2i4.94

ARTICLE HISTORY

Received: 28 April 2019
Revised: 18 May 2019
Accepted: 26 June2019

KEYWORDS

Mathematical representation
Geometry problem solving
Sex difference

ABSTRACT

This study aims to describe the mathematical representation of students solving geometric problems based on sex differences. Both subjects have equivalent mathematical abilities based on the results of the math ability test. The results showed that the subject used mathematical representation in expressing his idea to solve geometry problems by using Polya's problem solving steps: (a) understanding the problem (b) devising the plan (c) carrying out the plan, and (d) looking back. The mathematical representations of female subjects in solving geometric problems are: understanding information and what is asked verbally and symbolically, carrying the plans visually in the form of geometric formulas and mathematics, carrying out planning by drawing, and manipulating mathematical models, at the stage of looking back the subject performed symbolic recalculation. While mathematical representations of male subjects in express their ideas to solve geometric problems by: understanding information and what is asked verbally, devising the plans in visual form in the form of images and then making mathematical formulas, carrying out the plans by manipulating mathematical models that has been made and looking back by doing recalculation and writing conclusions.

1. INTRODUCTION.

Mathematics is the study of using graphs, tables, diagrams, and symbols (Rohimah, 2019). These symbols are used in mathematics to make it easier to understand mathematics itself. Graphs, tables, diagrams, and symbols presented are expressions of abstract mathematical ideas or concepts. This is also stated by Soedjadi (2000), namely in mathematics there are clearly many symbols used in letters or non-letters. Abstract mathematics will be more easily understood by images simple concept in mathematics. When students accept mathematical concepts in oral or written form, they will draw pictures in their minds. Image formation so that abstract mathematical concepts become concrete even if only in the mind. After the image is formed in the mind, they will express their ideas about the accepted mathematical concepts.

Representation is one of the five standard processes in mathematics learning (Fonna, 2018; Fonna, 2019; Anggraeni, *et al*, 2019). Five processes must be known and can use students as they progress through school: problem solving, reasoning and proof, communication, connection, and representation (NCTM, 2000). The process of formation, abstraction and demonstration in mathematics learning underlies representation as part of a standard process. Selling (2016, p. 191) reveals that we use a representational form to communicate ideas and tools for reasons. This shows that students involve a form of representation to express mathematical ideas. At the time of solving student problems are influenced by appearance problem for thinking idea mathematics to get a solution to the problem. Students build solutions to the problems they face starting in their minds, so people other people can find out the solution needs to be expressed in a form that can represent the results of his thoughts.

The branch of mathematics consists of algebra, geometry, numbers, statistics, and opportunities (Mullis *et al,* 2009; Bahri *et al*, 2019; Royani *et al*, 2019; Nurhadi *et al*, 2019). One material that contains problem solving at the junior level is geometry material. Fabiyi (2017) argues that geometry provides a rich source of visualization to understand the concepts of arithmetic, algebra and statistics. Geometry provides a rich source of visualization for understanding numbers, algebra and statistical concepts. Geometry discusses the nature and relationship of dots. lines, shapes, and spaces (Bergstrom & Zhang, 2016). Geometry has a very important role in mathematics learning, as a link between events in everyday life and mathematical concepts.

A person's mathematical abilities are estimated to be influenced by differences between sexes. Ceci & Williams, (2006); Park, Lubinski and Benbow, (2007); and Wai, Lubinski & Benbow, (2007), the influence of gender differences on cognitive abilities has long been a source of sharp debate and attention among researchers (Lakin, 2013; Winarso, 2019). This happens because of the gender implications of work that is closely related to mathematics and to the relevance of a person's personal profile.

Mathematical representation of students in solving problems can also be based on gender differences, some experts say that there are generally cognitive differences between male and female students. Krutetski (1976, p. 86) states that women are superior in accuracy, careful, accuracy, and precision in thinking. Unlike the case with men who generally tend to get things done in a short way. While Maccoby & Jacklyn (1974) describe differences between men and women, namely: (1) Women have verbal abilities better than men; (2) Men are superior in women's visual spatial abilities, (3) Men are superior in mathematical abilities. Correspondingly, research conducted by Mairing, Budayasa, & Juniati (2012) revealed findings that there were differences in problem solving carried out by male and female students. From the results of the above studies, due to differences in ability between men and women, the authors suspect that these differences have implications for the form of representation in solving problems.

Solve the problem revealed by Polya (1981) "Solving unknown problems to the end". Solving problems is an effort to determine the way out of the difficulties of getting the right solution to the problem. Solving problems in this study uses the stages revealed by Polya (2004) to understand the problem, devising the plan, carrying out thet plan, and look back.

2. LITERATURE REVIEW

2.1 Mathematical Representation

There are several opinions that explain the interpretation of representation. Kalathil & Sherin (2000) states his interpretation that representation is "Whatever students make and exemplify and show their work". The opinion explains that everything that students make to express and show their work is called representation. The definition of representation is also expressed by Gagatsis & Elia (2004, p. 447) which states that "Representation is defined as a configuration of characters, images, concrete objects, etc., which can represent or represent something". Gagatsis & Elijah reveals that representation is defined as a configuration of characters, images, concrete objects, which can represent or represent something else.

In line with the two meanings above, the idea of representation is also expressed by Goldin (2002, p. 178) "Representation is a configuration that can represent something else in several ways". This statement explains that, representation is a configuration that can represent something else. For example, words can represent real life objects, numbers can represent someone's height, or numbers can represent positions in the line numbers Godino & Font (2010) explain that representation is a sign or configuration of signs, characters or objects that can represent something else to symbolize, encoded, given a picture, or represented. The objects represented can vary according to the context or use of representations for example: cartesius charts, can represent functions or a series of solutions from algebraic equations. In certain cases, representation has a close relationship with mathematical concepts, such as graphics and functions, which are difficult to understand without certain representations.

Pape & Tchoshanov (2001, p. 120) states that there are four ideas used in understanding the concept of representation, namely:"First, representation can be considered broadly as a mental state. This internal representation of mental images, for example, is a set of five objects. , representation may be narrower is considered as a mental representation of an old mental state. This, number, 5, or number, five, is an example. In the end, the last two formulations include structurally equivalent 'pre-sentiment' through images, symbols or signs and something 'in lieu of something else. "

NCTM (2000) states that there are five standard processes in learning mathematics, " Five processes must know and be able to use students because they progress through school: problem solving, reasoning and proof, communication, connection , and representation "(p7). Five standard processes are interrelated in the process of learning and teaching mathematics, so they cannot be separated from mathematics learning. This shows that the ability of mathematical representation is one standard of ability that must exist in mathematics learning.

2.2 Form of Mathematical Representation

There are various forms of representation expressed by experts who conduct studies and research on representation in mathematics learning. In general there are two types of mathematical representations, namely internal representations and external representations (Pape & Tchosanov, 2001; Goldin & Steinghold, 2001; Salkind & Hjalmarson, 2007). Internal representation is a form of thinking about mathematical understanding. External representation is the embodiment of internal representation. External representations include numerical systems, mathematical equations, algebraic forms, graphics, geometric images, and number lines, including written or oral words (Salkind & Hjalmarson, 2007).

Goldin and Shteinghold (2001) say that, internal representation has 5 different system components, namely: (1) Verbal (syntestic) representation; (2) Formal Notation; (3) Imagistic of Representations; (4) Strategic and Heuristic Processes; and (5) Affective Representation System.

Panasuk & Beyranevand (2011) mentions mathematical representation as an internal abstraction of mathematical ideas or cognitive schemes. Internal representation cannot be observed because it is in the mental. To think of mathematical ideas, students need to present these ideas, giving them the opportunity to think about what is contained in the idea. Thinking about mathematical ideas which are then communicated requires an external representation whose forms include verbal, symbolic, and visual.

Another opinion expressed by Albert (200l), namely external repression is a representation that we can communicate to others, they mark on drawing paper, geometric sketches, and cauations. Internal representations of the images we have in our minds for reasoning and process mathematically.

The use of external representation is to communicate mathematical ideas associated with the concept in mind. representation as a communication tool and a tool for thinking about mathematical ideas which are then communicated require external representation that looks include: verbal, images and symbols.

According to Goldin & Shteinghold (2001): "Some external representation systems are mainly notation and formal. This includes our numbering system; the way we write and manipulate algebraic expressions and equations; our convention to show functions, derivatives, and integrals in calculus; and computer languages such as the Logo. Other external systems are designed to show visual or spatial relationships, such as number lines, Cartesian-based graphs, polars, or other coordinate systems, data box plots, geometric diagrams, and fractal images that are computer-generated. Words and sentences, written or oral, are also external representations. " (P.4).

The above statement confirms representation in three forms, namely: symbolic, visual, and verbal forms. Symbol forms include numerical systems, how to write and manipulate statements and algebraic equations, rules of express, derivative and integral functions. calculus, shape Visual including line numbers, graphs Cartesian, pole or coordinate system other data path bar charts, diagrams geometric and fractal image generated by a computer. form verbal include words or sentences, both orally and in writing.

These studies use the form of mathematical representation proposed by Goldin & Shteingold, namely:

1. Symbolic is a form of mathematical representation that states problem situations through symbols, mathematical models, calculates and manipulates mathematical models.
2. Visual is a form of mathematical representation that states a problem situation through a number line, graph, diagram, table or image.
3. Verbal is a form of maternal representation that states a problem situation through words or sentences, both written and oral.

3. RESEARCH METHOD

This study aims to determine how students' mathematical representation in solving geometry problems. In this study, researchers used a qualitative descriptive approach, which revealed and provided a description of the phenomenon or activity of the research subject qualitatively. The description of the phenomenon described in this study is the mathematical representation of junior high school students in solving geometric problems based on sex differences.

TKM (Mathematics Ability Test) was given to students of class VIII Al Falah Middle School. From the test results, two students with the same ability are selected who have a difference of less than five values between the two subjects to be discussed. Two selected students will be given geometry problem solving assignments.

4. RESULTS AND DISCUSSION

4.1 The Subjects Selection

Results of the subject selection were obtained by two subjects as in the following table.

Table 1. Research subjects

No.	Initials Subject	Score TKM	Sex
1	A	11	Female
2	B	11	Male

Both get the same score on the Mathematics Ability Test (TKM)
Task of geometry problem solving can be seen in Figure 1.

Misalkan ABCD adalah trapesium samakaki. $\overline{AD}$ dan $\overline{BC}$ diperpanjang sehingga berpotongan di titik E. Panjang $\overline{AB}$ = 30cm, panjang $\overline{CD}$ = 18cm dan tinggi trapesium 8cm. Jika F dan G berturut-turut adalah titik tengah $\overline{AD}$ dan $\overline{BC}$ dan panjang $\overline{FG}$ = 24cm, maka tentukan luas segitiga EFG!

Suppose ABCD is a trapezium. $\overline{AD}$ and $\overline{BC}$ are extended so that they intersect at point E. $\overline{AB}$ = 30cm, length $\overline{CD}$ = 18cm and height of trapezium is 8cm. If F and G each of the midpoints of $\overline{AD}$ and $\overline{BC}$ and the length of $\overline{FG}$ = 24cm, then specify the area of the EFG triangle!

Figure 1. Geometry problem solving tasks

The results of problem solving for female students can be seen in Figure 2. In Figure 2, students use symbolic and verbal representations at the stage of understanding. At the stage of designing the interview plan conducted about how students plan, students answer he will make a picture and will do calculations. This is also seen at the implementation stage of the plan, students make drawings based on information obtained in the next question to do calculations. Next the researcher asks how the student checks the answer, the student explains that he is recalculating. The overall results reinforce the results of Krutetski's (1976, p. 86) study which states that female are superior in accuracy, careful, accuracy, and precision in thinking, thus affecting their mathematical representation.

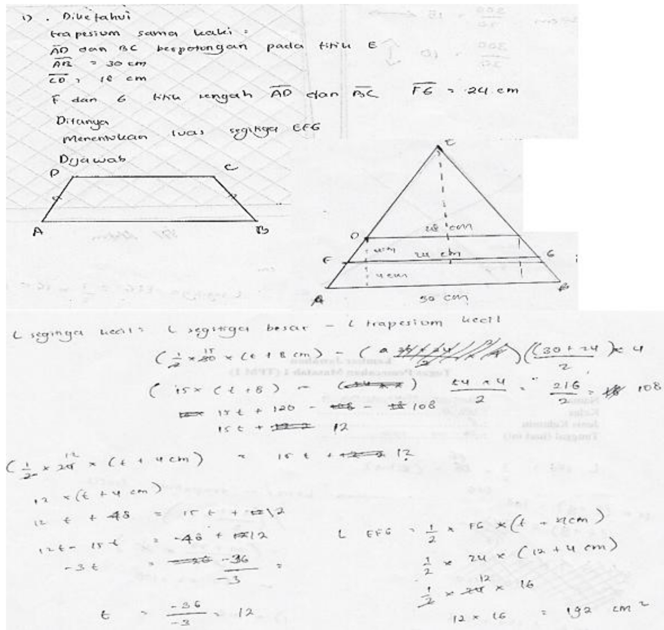

Figure 2. The problem solving of female student

The results of problem solving for male students can be seen in Figure 3. In Figure 3, students see verbal representations at the stage of understanding. At the stage of designing the interview plan conducted about how students plan, students answer he will make a picture and will do calculations. This is also seen at the implementation stage of the plan, students make drawings based on information obtained in the next question to do calculations. Next the researcher asks how students check answers, students explain that he did not check the results of the calculation.

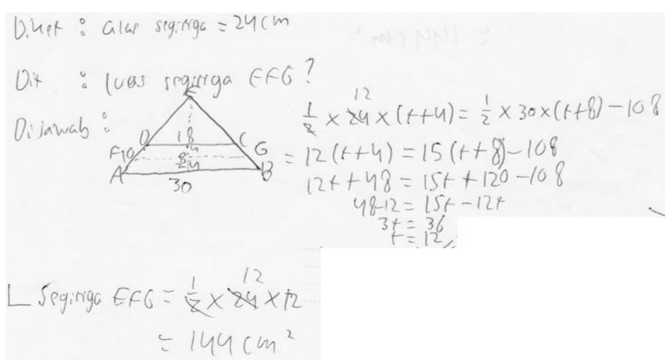

Figure 3. The problem solving of male student

Based on the overall representation of male students shorter than female students, this reinforces the opinion of Krutetski (1976) which states that male students generally tend to solve various things in a short way. While Maccoby & Jacklyn (1974) describe differences between men and women, namely: (1) Women have verbal abilities better than men; (2) Men are superior in women's visual spatial abilities, (3) Men are superior in mathematical abilities. Correspondingly, research conducted by Mairing, Budayasa, & Juniati (2012) revealed findings that there were differences in problem solving carried out by male and female students.

5. CONCLUSION

Based on the results of research conducted on Class VIII students at Al Falah Middle School. The researcher concluded that there were several differences in the mathematical representation of female and male students. In female students in the mathematical representation is seen in each step of completion and is generally stated in full, so that the results obtained are correct in solving problems. Whereas in the male students, mathematical representation is incomplete, for example at the stage of understanding students only write the base of a triangle. there is even a mathematical representation that does not appear in the problem solving step, namely at the checking stage again, so that the results obtained are wrong. In the overall results of this study, the mathematical representation of female students is better than male students, this is because female students are more thorough careful and accurary in solving problems.

Acknowledgements

Thank you for Al Falah Middle School Surabaya and Surabaya State University helped make this research successful.

REFERENCES

Anggraeni, R., Andriani, S., & Yahya, A. D. (2019). Effect of Thinking Aloud Pair Problem Solving (TAPPS) Method with Audio Visual Media for Students' Critical Thinking Ability. *International Journal of Trends in Mathematics Education Research*, *2*(1), 31-33.

Albert A. Cuoco. (2001). The Roles of Representation in School Mathematics 2001 Yearbook: National Council of Teachers of Mathematics.

Bahri, A. S., Lukito, A., & Masriyah, M. (2019). Students' Relational Thinking in Solving Word Problem Based Cognitive Style. *International Journal of Trends in Mathematics Education Research*, *2*(1), 37-39.

Bergstrom, C.. & Zhang, D. (2016). Geometry Interventions for K-12 Students with and without Disabilities: A Research Synthesis. International Journal of Educational Research, 80. 134-154.

Fabiyi, T. R. (2017). Geometry Concepts in Mathematics Perceived Difficult To Learn By Senior Secondary School Students in Ekiti State, Nigeria. TOSR Journal of Research & Method in Education (IOSR-JRME). 70 (1), 83-90.

Fonna, M., & Mursalin, M. (2019). Using of Wingeom Software in Geometry Learning to Improving the of Mathematical Representation Ability. *Malikussaleh Journal of Mathematics Learning (MJML)*, *1*(2).

Fonna, M., & Mursalin, M. (2018). Role of Self-Efficacy Toward Students' Achievement in Mathematical Multiple Representation Ability (MMRA). *Jurnal Ilmiah Peuradeun*, *6*(1), 31-40.

Gagatsis, A., & Elia, I. (2004). The Effect of Diferent of Representations on Mathematics Problem Solving. Procceding of the 28th conference of the international group for the psychology of mathematics education, Vol.2 P. 447-454. ERIC

Godino, J.D., & Font, V. (2010). The Theory of Representation As Viewed from the Onto-Semiotic Approach to Mathematic Education. Mediterranean Journal for Research in Mathematics Education, 9(1), 189-210.

Goldin , G.A. (2002). Representation in Mathematical Learning and Problem Solving. International Research in Mathematics Education. New Jersey: Lawrence Erlbaum Associates.

Goldin, G., & Stheingold, N. (2001). System of representations and The Development of Mathematical Concepts. The Roles of Representation in School Mathematics NCTM yearbook 2001. Reston: NCTM.

Kalathil, R.R., & Sherin, M.G. (2000). Role of Students' Representations in the Mathematics Classroom. In B. Fishman & S. O'Connor-Divelbiss (Eds), Fourth International Conference of the Learning Sciences (p. 27-28). Mahwah, NJ: Erlbaum.

Krutetski, V. A (1976). The Psychology of Mathematics Abilities in School Children. Chicago: The University of Chicago Press.

Lakin, J.M. (2013). Sex Differences in Reasoning Abilities: Surprising Evidence that Male-Female Ratios in The Tails of The Quantitative Reasoning Distribution Have Increased. Alabama: Department of Educational Foundations, Leadership, and Technology, Auburn University.

Macoby, EE., & Jacklyn, C.N. (1974). The Psychology of Sex Differences. Stanford: Standford University.

Mairing, J.P., Budayasa, I.K, & Juniati, D. (2012). Perbedaan Profil Pemecahan Masalah Peraih Medali OSN Matematika Berdasarka Perbedaan Jenis Kelamin. Jurnal Ilmu Pendidikan, 18(2).

Mullis, I. V. S., Martin, M. O. Ruddock, G. J., O'Sullivan, C. Y. & Preuschoft, C. (2009), TIMSS 2011 Mathematics Framework. Amsterdam: TIMSS & PIRLS International Study Center Lynch School of Education, Boston College.

NCTM. (2000). Principles and Standards for School Mathematics. Reston, VA: National Council of Teachers of Mathematics.

Nurhadi, M., Hizqiyah, I. Y. N., & Saraswati, A. (2019). Application of The Problem Based Learning Method Trought Authentic Assessment Approach to Improving the Habits of Mind. *International Journal of Trends in Mathematics Education Research*, *2*(2), 68-71.

Panasuk, R. M., & Beyranevand, M. L. (2011) Preferred Representations of Middle School Algera Students When Solving Problems. The Mathematics Educator. 13 (1), 32-52.

Pape, S.J., & Tschoshanov, M. (2001). The Role of Representation(s) in Developing Mathematical Understanding. Theory into Practice, Realizing Reform in School Mathematics (Spring, 2001). 40 (2), 118-127.

Polya, G. (1981). Mathematical Discovery: On Understanding, Learning, and Teaching Problem Solving. Printed in the United States of America.

Polya, G. (2004). How to Solve It: A New Aspect of Mathematical Method. With a New Foreword by John H Conway. United States of America: Princeton University Press.

Rohimah, S. M., & Prabawanto, S. (2019). Student's Difficulty Identification in Completing the Problem of Equation and Trigonometry Identities. *International Journal of Trends in Mathematics Education Research*, *2*(1), 34-36.

Royani, M., & Agustina, W. (2019). Junior High School Students Ability to Use The Polya's Step to Solve Mathematical Problems Through Problem Based Learning. *International Journal of Trends in Mathematics Education Research*, *2*(2), 86-90.

Salkind & Hjalmarson. (2007). Mathematical Representations. Spring. George Mason University.

Selling, S. K. (2016). Learning to represent, representing to learn. Journal of Mathematical Behavior. 41, 191-209

Soedjadi, R. (2000). Kiat Pendidikan Matematika Di Indonesia Konstatasi Keadaan Masa Kini Menuju Harapan Masa Depan. Direktorat Jenderal Pendidikan Tinggi Departemen Pendidikan Nasional: Jakarta.

Winarso, W., & Haqq, A. A. (2019). Psychological Disposition of Student; Mathematics Anxiety Versus Happiness Learning on the Level Education. *International Journal of Trends in Mathematics Education Research*, *2*(1), 19-25.